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# ESAJECT

## ESA Ejection System

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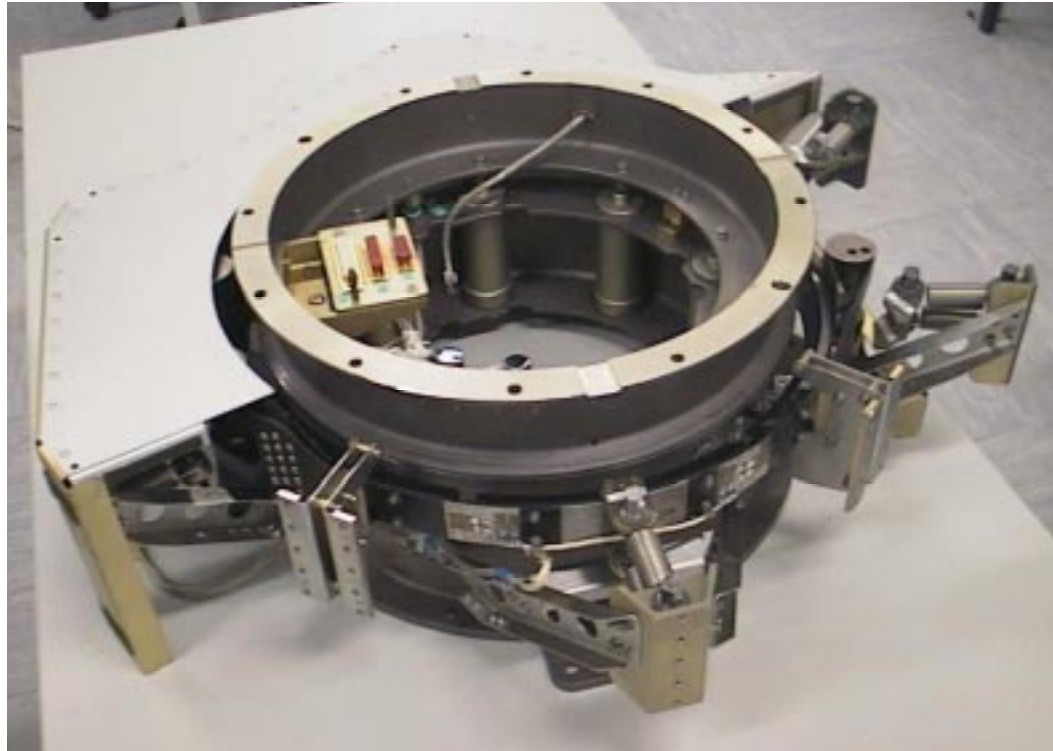
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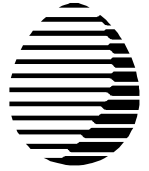
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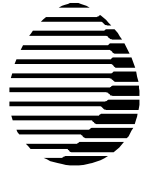
## ▪ ESA Ejection System

- **Ejection** or **jettison** of small payloads from the Hitchhiker Bridge
- System is developed under **ESA's Technology Demonstration Program**
- First flight for the ejection of the satellite Sloshsat, as part of the **Hitchhiker TAS-03 mission**



## ■ Main Safety Features

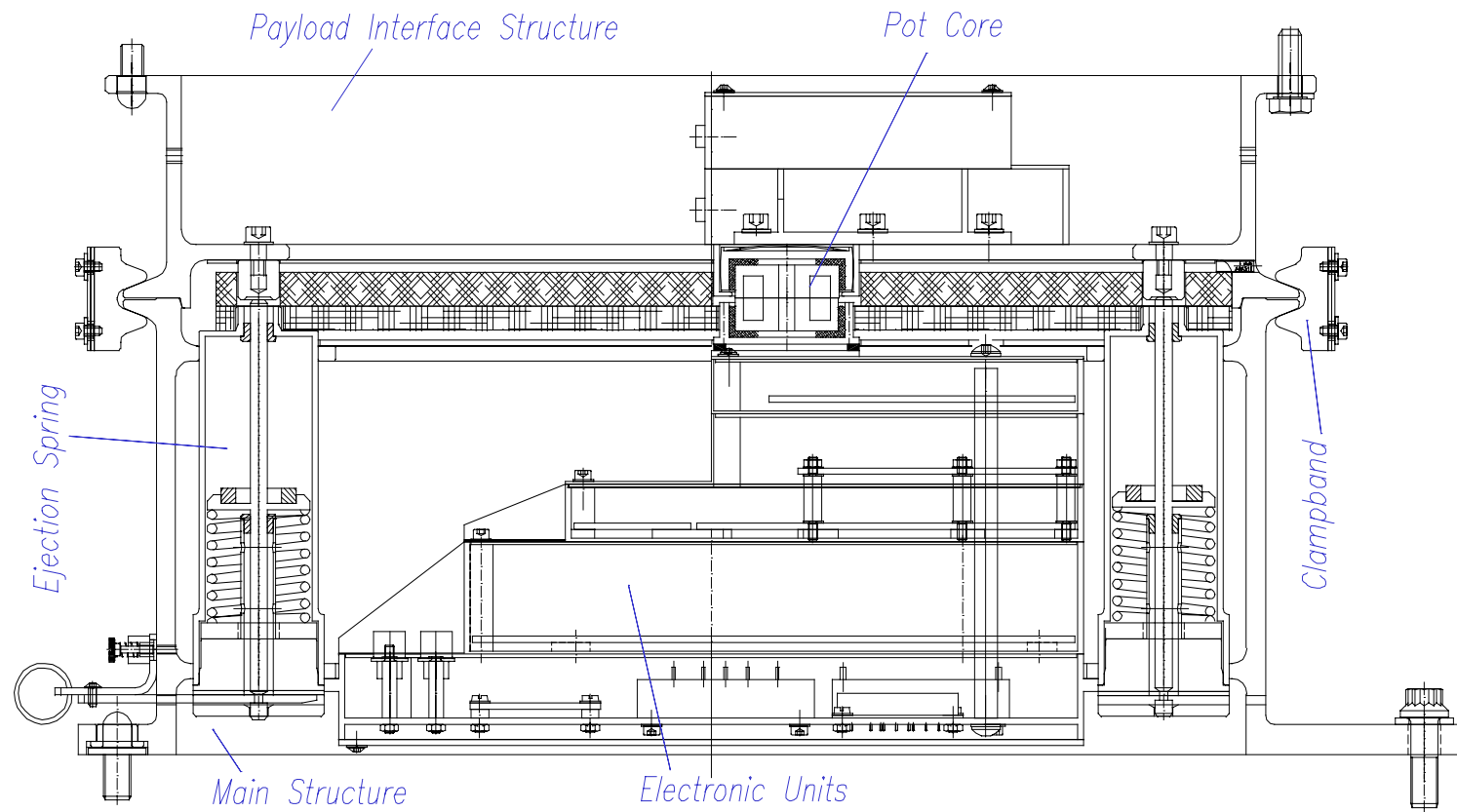
- Equipped with a **"jamming free"** power and data transfer system.
- **No guiding** system
- **Single-failure tolerant** system
- Can be used as **"safety backup"** device to jettison failed payloads (e.g. blocked robotic arm)
- **Firing circuit** protected with **three independent inhibits** to prevent unintentional firing of the system
- **Remotely activated** by the flight crew from the **Standard Switch Panel (SSP)** on the orbiter Aft Flight Deck (AFD).
- System can be equipped with a **battery** to be independent of the orbiter power supplies (**option** not further developed in Esaject)



## ■ Main design drivers

- **Ejection** and **Jettison** function (use as safety backup device)
- **Single-failure tolerant** against refusing to fire (**ejection**)
- **Two-failure tolerant** in combination with payload in **jettison** case (first failure on payload)
- **Two-failure tolerant** against **unintentional firing**
- Prevent inadvertent ejection with a minimum of three independent inhibits
- May not be initiated from ground
- Design-Lifetime **three missions**
- Ejection of payloads from **50 - 150 kg** with a nominal ejection **velocity of 0,8 m/s (min 0,3 m/s)**
- Battery pack (development not part of actual contract) can be provided to be independent from Orbiter power for ejection/jettison

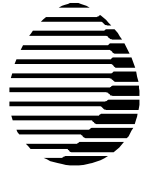
# System Description



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## ■ Mechanical

- Main Structure
- Payload Interface Structure
- Outer cover
- Ejection Spring assy
- Marman Clampband
- Separation Bolt
- Retraction / Retention System
- Debris Capture Device

## ■ Electrical

- Electronic Box
- Power and Data Transfer System
- Pyrotechnic Firing Circuit

## Main Structure

- main (inner) structure, fabricated from AA 7075-T7352
- transfers the loads to the HH Double Bay Pallet.
- main structure is 155 mm high and is made from a single part
- electronics box is mounted inside, remaining subsystems mounted on the structure itself.
- connectors and harness to the outside are routed via feed through in the structure

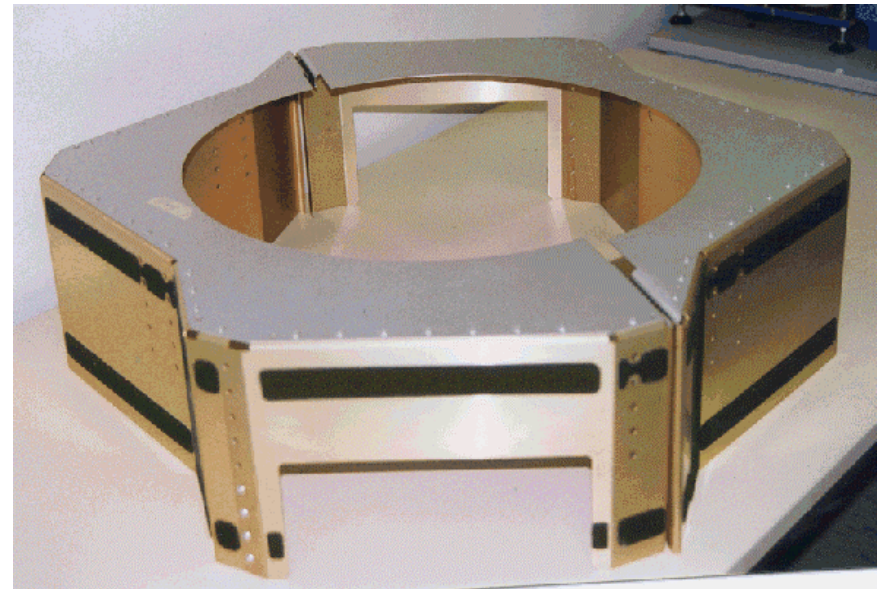
## Payload Interface Structure

- Payload Interface Structure, fabricated from AA 7075-T7351
- interface between the lower part of the ESAJECT system (main structure) and the payload
- houses the payload-side part of the pot core based power and data transfer system
- keyed to provide for correct installation on the main structure
- contact surfaces of the separation interface plates with the marman band will be coated with NiFlor (Ni coating with PTFE)



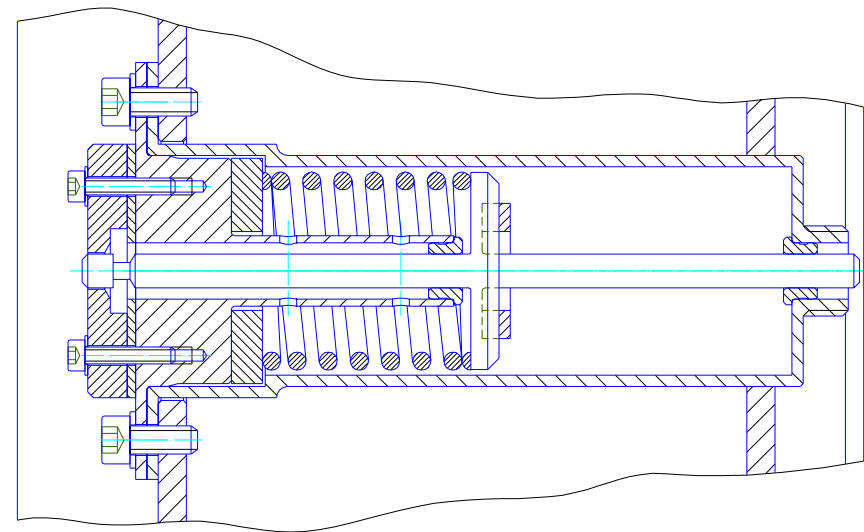
## Outer Structure

- outer structure is actually a non-load bearing cover mounted to the retraction spring brackets
- provides for installation of the Multi-layer Insulation (MLI) thermal blanket
- in two sections, any of which may be removed without disturbing the payload



# Ejection spring assy

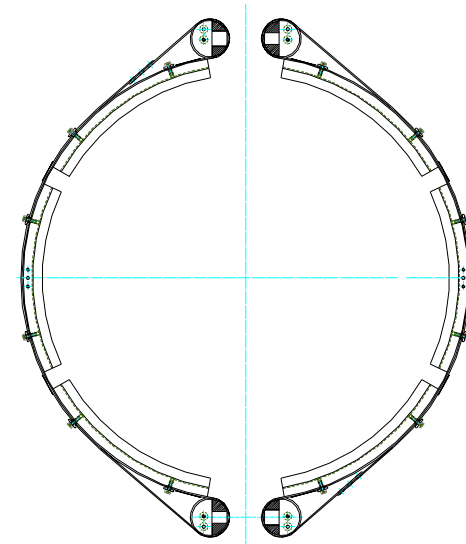
- 8 spring assemblies equally spaced around the perimeter of main structure
- separation spring - cold coiled stainless steel (AISI 301)
- push rod - stainless steel (AISI 431)
- bushing - vespel
- guide and housing
- nominal ejection velocity 0.8 m/s, min. 0.3 m/s in case of spring failure
- stroke pre-determined prior to integration system
- spring assemblies initial force within +/- 7.5%.



# Marman Clampband



- two nickel-alloy bands (Ni 718) with three floating Aluminium-alloy clamps on each side of the two bands
- pre-tensionmonitored through redundant sets of strain gauges
- coated with XYLAN 1010 dry lubricant
- clamp band halves held in place by two pyrotechnically operated Separation Bolts which are set 180 degrees apart
- Separation of either bolt will release the clamp and allow the payload to be ejected



# Separation Bolt



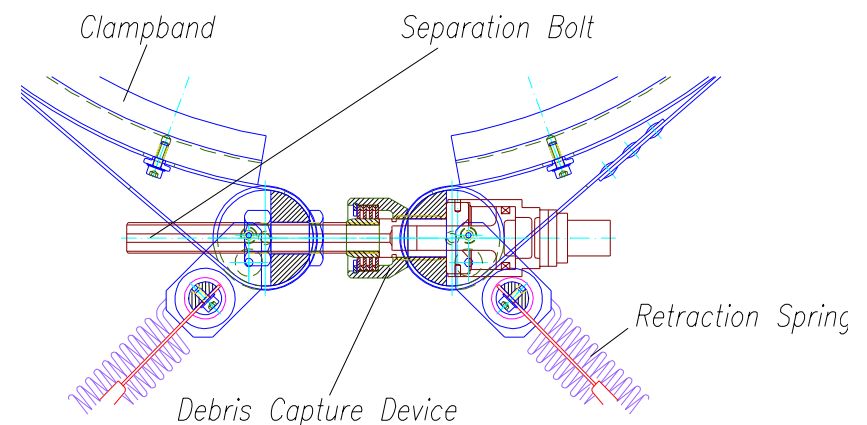
## separation bolt

- pyrotechnically initiated separation bolts
- energy for actuation provided by NASA Standard Initiator (NSI)-actuated booster cartridge
- “velocity piston” design, uses the kinetic energy of the piston to effect separation



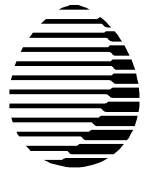
## debris capture device

- design derived from a concept first used on ESA's ERS-1 satellite
- four silicon rubber membranes separated with spacers
- Each membrane has a 90 degree slit and they are set 90 degrees shifted in the assembled configuration

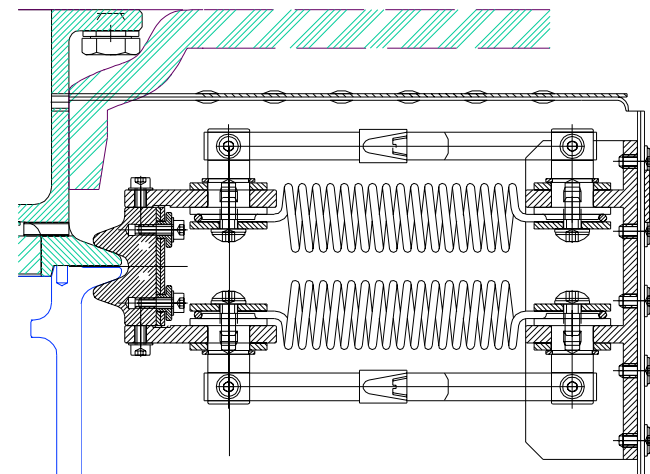


# Retraction / Retain Mechanism

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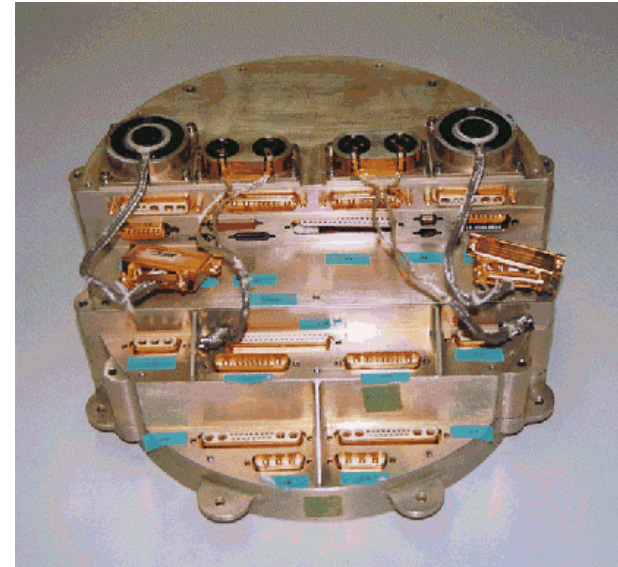


- set of spring loaded devices which pull the halves of the marman clamp band away after pyrotechnic operation
- respond quickly enough to prevent an asymmetric ejection
- prevent rebound and possible recontact with the ejecting payload (ty-rap locking system)
- Each mechanism consists of 3 sets of springs attached on one side to the clamp band half
- Each set of springs consists of a right-hand and left-hand wound spring to avoid blocking or interference with adjacent springs.



# Electronic Box

- stacked configuration located inside the main structure
- contains command and monitoring circuitry, including associated pyrotechnic circuitry
- box will interface through the standard Hitchhiker electrical interfaces

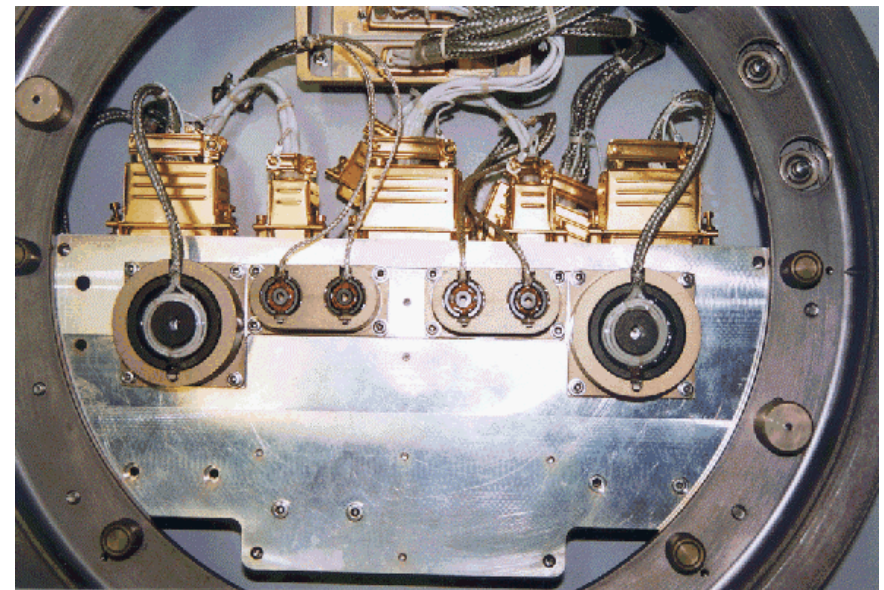




# Data - Power Transfer System



- Contactless pot core system; jamming free
- connectors are ferrite pot cores, use electromagnetic induction to transmit the desired data and power
- make contact at the separation plane, thus half of the connector is on the payload side of the interface, and will be ejected as part of the satellite
- redundant sets of pot cores
- spring-loaded mechanism located in the upper part provides the necessary mechanical pressure between the two halves



# Power - Data Transfer System



## Data Transfer

- 16 bit bi-directional parallel data transfer
- redundant Manchester-coded serial data links using shift-registers for parallel/serial data conversion
- electronics based on commercially available CMOS Manchester Encoder-Decoder Chip per MIL-STD-1553.
- Independent encoder-decoder sections on the chip allow full duplex data communication
- data rate is 1 Mbit/sec, which corresponds to a transfer rate of 50 Kwords per second

## Power Transfer

- galvanic isolation by DC/DC converter, powered via an Electromagnetic Interference (EMI) filter from the HH avionics port
- After the DC/DC converter, the PTS converts the output (28V) to the output on the satellite (28V @ 3A).





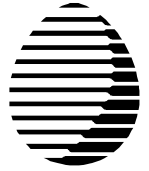
## ▪ Switch panel

- complete commanding for pyrotechnic fire given to the crew via the SSP interface
- Four switches located on the Aft Deck Switch Panel are used for the ejection (Pré-Arm, Arm, Fire 1 and Fire 2)
- Any combination of three switches out of four will initiate the ejection, the fourth switch is used for redundancy
- status of the 3 independent inhibits is indicated by the PRE-ARM and ARM indicators.

# Project status - Planning

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- Esaject is built according the **protoflight philosophy**
- phase B, major activities was the evaluation of the ejection trajectory
- dynamic analysis performed with DCAP and verified by ejection tests on a mechanical breadboard and high-speed camera recording
- flight model currently under integration and qualification testing
- Esaject will go to NLR for system integration and testing with Sloshsat, after which it will be ready for shipment to GSFC for integration on the Hitchhiker.
- Esaject with Sloshsat (STOF) is planned to fly on the **Hithchiker TAS-03** mission (in 2000 - 2002 time frame).